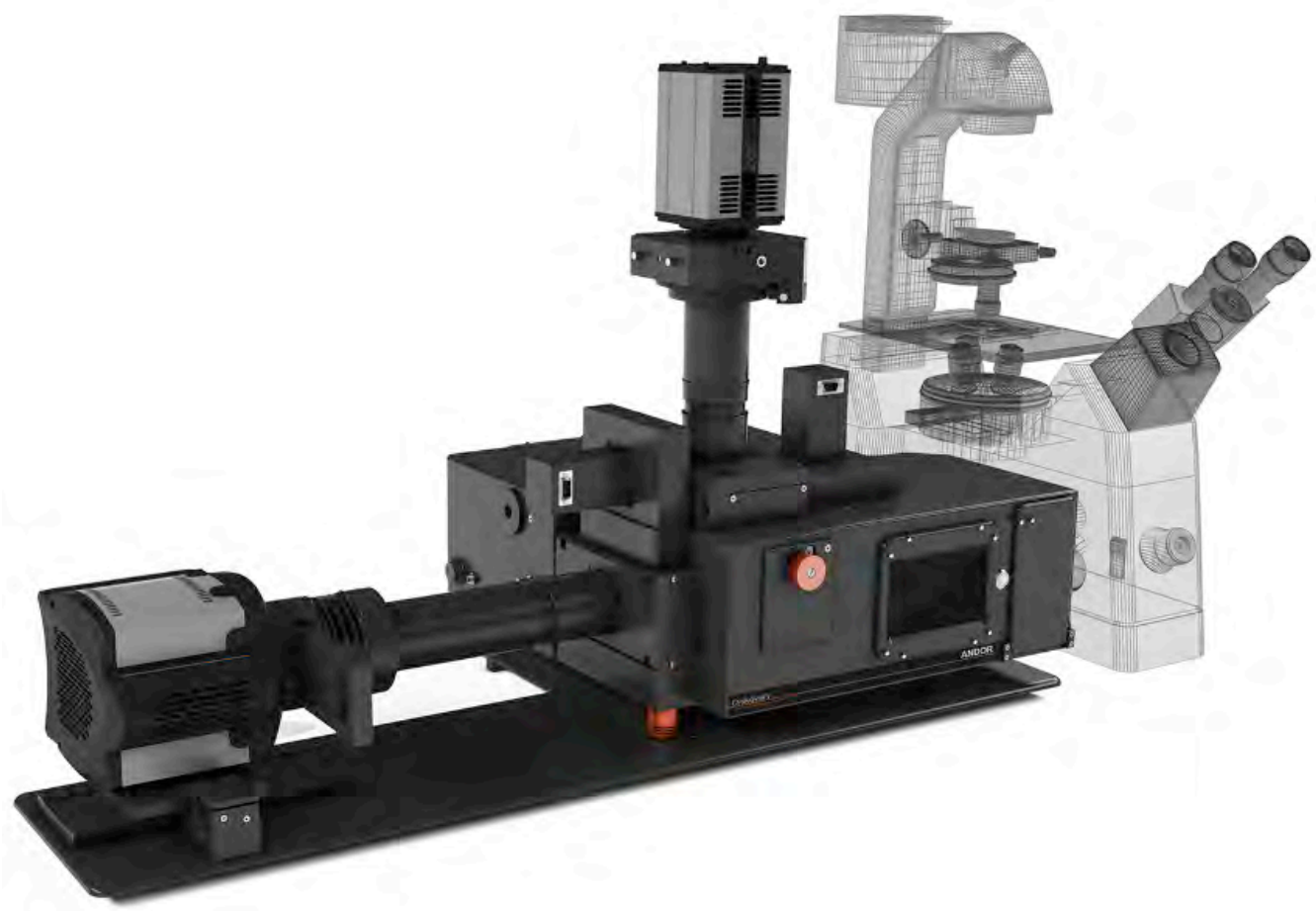
ANDOR
an Oxford Instruments company

Diskovery

Version 1.1 revised 04 June 2015



User Guide

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TABLE OF CONTENTS

SAFETY AND WARNING INFORMATION 6

SECTION 1: INTRODUCTION 15

1.1 TECHNICAL SUPPORT 16

1.2 DISCLAIMER 17

1.3 COPYRIGHT AND PROTECTIVE NOTICES 17

1.4 TRADEMARKS AND PATENT INFORMATION 17

1.5 SUPPLIED COMPONENTS 18

1.6 OPTIONAL COMPONENTS 19

SECTION 2: PRODUCT OVERVIEW 20

2.1 GENERAL 20

2.2 SYSTEM CONFIGURATIONS 21

2.3 INTERFACES AND CONTROLS- LEFT SIDE PANEL 22

2.3.1 Power Input 22

2.3.2 ON/OFF Switch 22

2.3.3 USB 22

2.3.4 Interlock Output 22

2.3.5 Fibre Input 22

2.4 INTERFACES AND CONTROLS- FRONT PANEL 23

2.4.1 LCD Touchpad 23

2.4.2 Manual Dichroic Selector Module 23

2.4.3 Disk Cassette Access Door 23

2.5 POWER SUPPLY 23

2.6 DISKOVERY- SYSTEM INTEGRATION 24

2.6.1 Overview 24

2.7 OPTICAL PATHS 25

2.7.1 Bellows Adapter 25

2.8 LASER SOURCES 25

2.9 INTERLOCKS 26

SECTION 3: INSTALLATION 27
3.1 LOCATION AND MOUNTING 27
3.2 VENTILATION 27
3.3 ASSEMBLY 27
3.4 FILTER WHEELS 27
3.5 CLASSIFICATION OF AN INSTALLED SYSTEM 28
SECTION 4: OPERATION 29
4.1 EMERGENCY MAINS DISCONNECTION 29
4.2 POWER-UP SEQUENCE 29
4.3 POWER-DOWN SEQUENCE 30
4.4 RISK MITIGATION 30
4.4.1 Mechanical Housings 30
4.4.2 Hazards due to Moisture or Liquids 30
4.5 USING THE DISKOVERY 31
4.5.1 LCD Touchpad User Interface 31
4.5.2 Computer Control Utility Application GUI 33
4.6 DISKOVERY CONTROL: ABOUT 37
4.7 ADDITIONAL PROCEDURES 38
4.7.1 Removing the disk cassette 38
4.7.2 Exchanging a disk cassette 39
4.7.3 Operating the Diskovery Excitation Filter Wheel 40
4.7.3.1 To check if the excitation filter wheel is active (i.e. installed) 40
4.7.3.2 To move the excitation filter wheel to one of the preset filter positions 40
4.7.3.3 To query the current position of the excitation filter wheel 40

SECTION 5: MAINTENANCE 41
5.1 CLEANING AND DECONTAMINATION 41
5.2 REGULAR CHECKS 41
5.3 ANNUAL ELECTRICAL SAFETY CHECKS 41
SECTION 6: TROUBLESHOOTING 42
6.1 TROUBLESHOOTING EXAMPLES 42
6.1.1 No External Power Error Message 42
6.1.2 Confocal Access Door Open Error Message 42
6.1.3 No Laser Power at Diskovery 42
6.1.4 Low Laser Power at Diskovery 42
6.1.5 Poor Uniformity over Camera FoV 42
6.2 PROBLEM REPORTING FORM 43
SECTION 7: TECHNICAL SPECIFICATIONS 44
7.1 DISKOVERY- GENERAL SPECIFICATIONS 44
7.2 BELLOWS ADAPTER 44
7.3 ENVIRONMENTAL SPECIFICATIONS 44
7.4 POWER SPECIFICATIONS 44
APPENDIX A: MECHANICAL DRAWINGS 45
APPENDIX B: GLOSSARY 46
APPENDIX C: OTHER INFORMATION 47

Revision History

Version	Released	Description
Rev A	24 Dec 2014	Initial Release for production
1.0	21 May 2015	Updated presentation and information (all sections).
1.1	04 Jun 2015	Updated Figure 8 to show compliance label and serial ID for both Laser Class 3B and Class 4 Diskovery units.

Safety and Warning Information

PLEASE READ THIS INFORMATION FIRST

CAUTION – USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE.

1. If the equipment is used in a manner not specified by Spectral or Andor, the protection provided by the equipment may be impaired.
2. Do not position this product so that it is difficult to operate the Mains disconnecting device. See SECTION 4.1, “Emergency Mains Disconnection”.
3. Before using the system, please follow and adhere to all warnings, safety, manual handling and operating instructions located either on the product or in this User Guide.
4. Users must be authorised and trained personnel only; otherwise this may result in personal injury, and/ or equipment damage and impaired system performance.
5. The Diskovery weighs over 18 kg (40 lbs) depending on system configuration, and therefore requires due consideration during manual handling for transport and installation. When mounted on the sled the Diskovery and sled weighs 27 Kg (60 lbs) and must be lifted by two people.
6. Ensure fibre cables are not bent tightly as this may damage the internal optical fibre. For transport or storage, fibre cables should be coiled with a diameter of 300 mm or greater.
7. Locate the laser source, BCU, and Diskovery within 2 m of each other so that the interconnecting fibres are not stretched, bent, or constrained.
8. This product will be used with lasers.
9. IEC Technical Document IEC TR 60825-14 recommends the presence of a Laser Safety Officer (LSO); however, national guidelines should be referred to.
10. Do not attempt to bypass any safety interlocks. They are provided to comply with the safety requirements of various regulatory agencies and must be employed to protect the operator.
11. Protective earth is an integral part of the protection against electric shock in this product, and is provided via the earth pin of the external power supply. Ensure that this is plugged into the building earth system via the mains socket. Do not tamper with any of the earthing measures.
12. Only the correctly specified mains supply should be used.
13. Only the AC/DC external power supply provided with the product should be used.
14. Only the power supply cord provided with the product should be used. Should this not be correct for your geographical area, contact your local Andor representative.
15. Make sure the power supply cord is located so that it will not be subject to damage. If replacement of the detachable power supply cord is required, ensure replacement is of same type and rating.
16. While running an experiment, try to keep room temperature as stable as possible.
17. This equipment has not been designed and manufactured for the medical diagnosis of patients.
18. Performance of the system may be adversely affected by rapidly changing environmental conditions or operation outside of the operating conditions specified in SECTION 7 “TECHNICAL SPECIFICATIONS”
19. Electromagnetic Compatibility: This is a Class A product. In a domestic environment this product may cause electromagnetic interference, in which case the user may be required to take adequate measures.

20. This product has been designed and tested to perform successfully in a normal (basic) electromagnetic environment, e.g. a typical life science test laboratory, as per the EU EMC Directive. It is not designed to operate in a harsh electromagnetic environment, e.g. close to the following equipment: EMI/RFI generators, electrostatic field generators, electromagnetic or radioactive devices, plasma sources, arc welders, x-ray instruments, intense pulsed sources, or other similar sources of high energy fields whose emissions are not within the normal range expected under the EU EMC Directive.
21. Your product is a precision scientific instrument containing fragile components. Always handle it with care.
22. There are no user-serviceable parts inside the product and the enclosure must not be opened. Only authorised service personnel may service this equipment.
23. Do not wet or spill liquids on the product, and do not store or place liquids on the product.
24. If spillage occurs on the product, switch off power immediately, and wipe off with a dry, lint-free cloth.
25. If any ingress of liquids has occurred or is suspected, unplug the mains cables, do not use, and contact Andor Customer Support.
26. See SECTION 5.1, “Cleaning and Decontamination”.
27. Do not expose the product to extreme hot or cold temperatures.
28. Do not expose the product to open flames.
29. Do not allow objects to fall on the product.
30. Keep this User Guide in a safe place for future reference.

Laser Safety

CAUTION – USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE

This product is designed to be integrated with lasers that cover the entire visible spectrum and extend into the invisible infra-red spectrum. This section of the manual is designed to make the end-user aware of the hazards of the product due to these lasers. Laser safety hazards differ from those of normal light sources and users must be familiar with the hazardous properties of lasers as these are highly-concentrated, low divergence beams of radiation.

Andor recommend that all facilities have an established system for the safe use of lasers as per their national frameworks and Occupational Health and Safety legislation. Laser Safety standards IEC 60285-1 and American National Standard Z136.1-2007 - Safe use of Lasers may be useful references for good practice.

Laser Product Classification

The Diskovery does not contain any embedded Laser Sources but it is intended to be integrated with a compatible Laser Source and has therefore been designed to safely accept, and handle Laser Radiation. The Diskovery unit and all ancillary components of the Diskovery system have been designed and labelled to be compliant with IEC 60825-1 and CDRH Title 21 CFR 1040.10.

When assembled and integrated in the intended manner, Diskovery will form part of a unique laser product formed by the entire system. The Classification of this product will depend entirely on the Laser source connected and the associated research-grade microscope. Therefore the final assemblage must be assessed, Classified and labelled in accordance with the requirements of IEC 60825-1 and CDRH Title 21 CFR 1040.10.

This must be performed by a competent, trained individual, e.g. the site's Laser Safety Officer. In the case of the System being installed by an Andor representative, it is Andor's responsibility to assess and classify the final system. The Customer Support Engineer will be competent and trained to perform this and ensure that the system is correctly classified and labelled. Please refer to section 2.5 for guidance on the assessment and classification procedure.

Laser Safety Information

All relevant safety compliance information is visibly displayed on the product as per the International Laser Safety Standard IEC 60825-1 and the U.S. Laser Product Performance Standard 21 CFR 1040.10.

As the Diskovery system will form part of a unique configuration of components, it cannot be classified in isolation. Therefore when integrated, it may form part of a system with one of the classifications described below. A label in the format depicted below will be included for application by the System Integrator following assessment and classification. The Diskovery may be configured as part of a larger system that includes multiple Class 3B and Class 4 lasers. A number of separate emission wavelengths can also be available in any one system. In some very rare occasions another classification label may be used, this will be explained in additional documentation as appropriate.

Class 3B

LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
500mw CW Max at 400 - 700nm
CLASSIFIED PER IEC 60825-1 (2007 ED2.0)

VISIBLE AND INVISIBLE
LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT
500mw CW Max at 400 - 785nm
CLASSIFIED PER IEC 60825-1 (2007 ED2.0)

Laser products that are normally hazardous when intrabeam ocular exposure occurs (i.e. within the Nominal Ocular Hazard Distance, NOHD) including accidental short time exposure. Viewing diffuse reflections is normally safe. Class 3B lasers which approach the Accessible Emission Limits (AEL) for Class 3B may produce minor skin injuries or even pose a risk of igniting flammable materials. However, this is only likely if the beam is a small focused spot.

Note: There exist some theoretical (but rare) viewing conditions where viewing a diffuse reflection could exceed the Maximum Permitted Exposure (MPE). For example for Class 3B lasers having powers approaching the AEL, lengthy viewing of greater than 10 s of true diffuse reflections of visible radiation and viewing at distances less than 13 cm between the diffusing surface and the cornea can exceed the MPE.

Class 4

LASER RADIATION
AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT
2000mW CW Max at 400 - 700nm
CLASSIFIED PER IEC 60825-1 (2007 ED2.0)

VISIBLE AND INVISIBLE
LASER RADIATION
AVOID EYE OR SKIN EXPOSURE TO
DIRECT OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT
2000mW CW Max at 400 - 785nm
CLASSIFIED PER IEC 60825-1 (2007 ED2.0)

Laser products for which intrabeam viewing and skin exposure is hazardous and for which the viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard.

Laser Classification Labelling Locations

The Access Panel and Classification / Explanatory Labels of the Diskovery are located as shown. If the Diskovery is to be re-classified by the site's trained and competent individual (e.g. the site's Laser Safety Officer) then they must ensure that labels of the correct classification and wavelength range are placed in all of the locations indicated below. A further explanation of these labels is described in the following sections.

Figure 1: Top Panel of the Diskovery - Locations of Laser Classification and Explanatory Labels

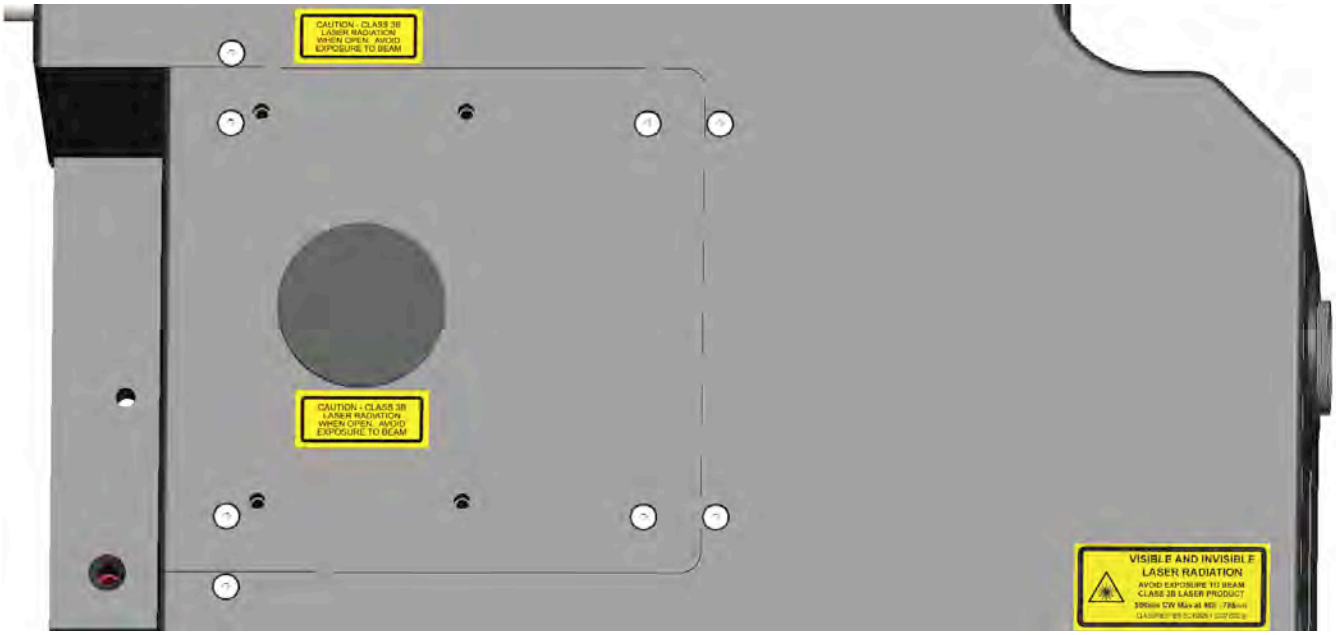

Figure 2: Camera 2 Panel- Label Attached if Second Camera is not Present (Diskovery Top View).

Figure 3: TIRF Housing Panels (Diskovery Top View)

Figure 4: TIRF Blanking Panel (If TIRF Module is not present).

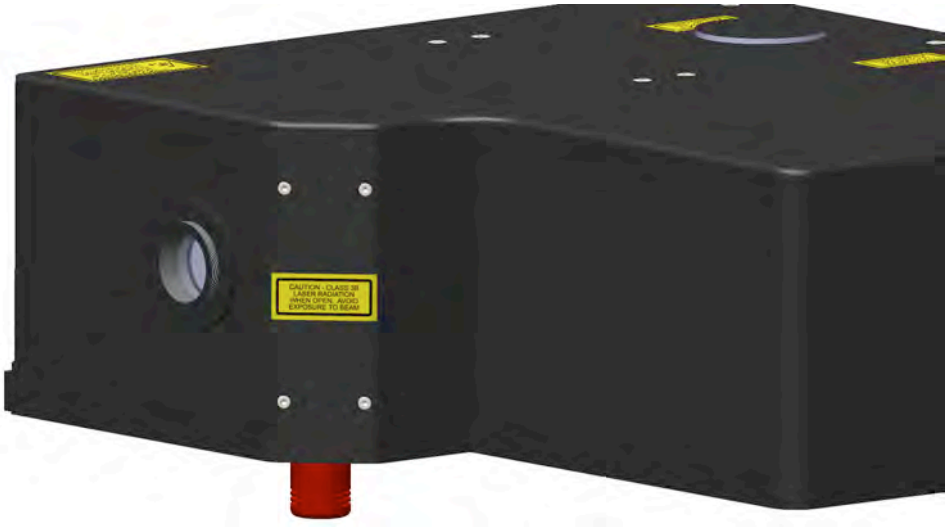

Figure 5: Diskovery Right Hand Side - Locations of Laser Classification and Explanatory Labels

Figure 6: Diskovery Front Panel - Locations of Laser Classification and Explanatory Labels

Aperture

The System Integrator MUST ensure that the final system's Laser Aperture is suitably labelled e.g. the microscope's Objective is identified by a label on the microscope's stage top. An example is shown below.
The appropriate aperture label is included with the documentation for application by the System Integrator.

Figure 7: Example of Laser emission warning label on microscope

Description of Emitted Radiation from the Laser Product

Parameter	Values	Notes
Wavelengths	400-785 nm	Exact outputs will depend on the integrated laser source, please refer to it's Explanatory Label and User Documentation
Beam Divergence	0.3-1.4 NA	Exact divergence will be dependent on the objective in use, please refer to the microscope's User Documentation
Maximum Power or Energy Output	<1W	The maximum output power will depend on the integrated laser source and the configured optical elements but will be significantly less than 1W (Class 4)
Pulse Duration	N/A	All recommended laser sources for the Borealis Product are Continuous Wave output
Pulse Repetition Rate	N/A	All recommended laser sources for the Borealis Product are Continuous Wave output
Irregular Pulse Pattern	N/A	All recommended laser sources for the Borealis Product are Continuous Wave output

Description of Emitted Radiation from the Integrated Laser Source

This is dependent on the laser source integrated with the Diskovery system. As there are multiple options available from Andor or Diskovery may be integrated with a customer's existing laser source please refer to the Laser Source's Explanatory Label and User Documentation for a description of its Emitted Radiation.

Recommended Responsibilities of a Laser Safety Officer

These include, but are not restricted to, the following; however, national guidelines should also be referred to:

1. Ensuring all personnel requiring access to the product are fully trained in both using the product and the general use of Class 3B and Class 4 lasers (see below).
2. Ensure users are familiar with the hazardous properties of lasers; namely that laser safety hazards differ from those of normal light/radiation sources as they are high-intensity, highly collimated beams of electromagnetic radiation.
3. Ensuring the equipment is used in a controlled area by trained end users in accordance with national guidelines.
4. Ensuring end-users are familiar with the operation of the laser's key switch control, interlocks, emission LEDs and other safety features.
5. Ensuring that all interlocks are connected and functioning correctly.
6. We recommend that a copy of IEC 60285-1 is purchased by the laser safety officer for reference.

Guidelines for Safe Operation of Laser Products

1. Read the safety instructions supplied with all equipment in the system.
2. Never look into a laser beam either directly or indirectly.
3. Do not attempt to disassemble the unit housing the lasers or any part of the system. If there is a problem please contact Andor directly (see SECTION 1.1, "Help and Technical Support").
4. Restrict and control access to the area(s) where laser(s) are in use to those persons who are trained in the dangers of lasers and trained on the safety precautions to be observed when working with lasers.
5. Ensure suitable laser warning signs are prominently displayed in the area the system operates.
6. If the system is not in use turn the laser off using the key switch.
7. On a daily basis, or before every use, verify that the laser interlock circuit is working by confirming that the laser emission indicator on the source turns off when any of the following are done:
    - The microscope binocular eyepieces are in the open position.
    - The articulated transmitted light arm on inverted microscopes is tilted back from the functional vertical position before using the system.
8. If it is necessary to visually locate and indicate the output of invisible wavelengths, laser viewing cards for this purpose e.g. Thorlabs NIR Detector Card VCR5 for 700- 1400 nm must be used along with the appropriate laser safety goggles.
9. Additional precautions may need to be implemented as the necessary precautions will be specific to each system installation, configuration and typical mode of use. The responsible Laser Safety Officer must assess and implement the necessary precautions to avoid possible exposure to hazardous radiation during use.

Eye Protection

Eye Protection is not required for the safe use of the device as the only radiation observable (without intentional misuse) is directionally stable, diffuse and highly divergent from the designated aperture which is static and labelled.

If eye protection is deemed desirable by the local Laser Safety Officer, Andor recommends the following products:

- 360 nm – 510 nm – Kentek KXP-4001 Spectacles
- 510 nm – 670 nm – Kentek KRA 6702 Spectacles
- 670 nm – 800 nm – Kentek KMZ-215C Spectacles

Working with Optical Fibres

1. Only service personnel authorized by Spectral or Andor should remove or inspect fibres.
2. The laser radiation passing through fibres is potentially hazardous, so great care should be taken to avoid exposure to this radiation.
3. The fibre can be easily damaged by bending or general mishandling. Ensure that the minimum curvature is never exceeded when handling. Recommended minimum bend radius is 30 mm.
4. Optical fibres are prone to damage by bending local to the connector.
5. The coupler is not designed to withstand pulling of the fibre. If the fibre is pulled the system performance could be compromised or the system may fail.

Serial and Compliance Label

The label below is located on the rear panel of the Diskovery. It indicates compliance with the applicable standards. It also provides information on the manufacturer and identifies the model and its laser classification, serial number, and manufacturing date (month, year).

Spectral Applied Research Inc.
A Division of Andor Technology
2 East Beaver Creek Rd., Bldg. #2
Richmond Hill, ON L4B 2N3 Canada
(905) 326-5040; www.spectral.ca
This product complies with IEC 60825-1:2007 and 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated 2007/06/24.
Model: CR-DSK-CONF-3B
Serial No.: DSK52030
Mfrd: December 2014
Spectral Applied Research Inc.
A Division of Andor Technology
2 East Beaver Creek Rd., Bldg. #2
Richmond Hill, ON L4B 2N3 Canada
(905) 326-5040; www.spectral.ca
This product complies with IEC 60825-1:2007 and 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated 2007/06/24.
Model: CR-DSK-CONF-4
Serial No.: DSK52030
Mfrd: December 2014

Figure 8: Compliance and Serial Identification labels on rear panel of the Diskovery. Example shown for a Diskovery unit classified as a Class 3B Laser Product, (Left) and for a Class 4 Laser Product (Right).

Explanation of Product Symbols

This symbol found on the power input connection indicates that the Diskovery requires a Direct Current (DC) power supply. Information on the supplied power supply and requirements is detailed in Section 2.3.

This label is located on the Diskovery sled (mounting platform) to the right of the confocal output. This indicates that the Diskovery requires a two person for transport and installation (refer to Section 3).

SECTION 1: INTRODUCTION

This manual provides an overview of the Diskovery and its integration and function as a multi-modal imaging system. Diskovery, developed by Spectral, offers several applications within the same package: Spinning disk confocal microscopy, total internal reflection fluorescence (TIRF) microscopy, and widefield super-resolution localization microscopy. Thus, Diskovery has the following features:

- Multiple techniques can be used without changing set-ups on the same sample
- Computer or manual control (using a LCD touchpad interface display)
- Flexible bellows attachment to the microscope
- Switchable camera lens tubes

Diskovery is manufactured by:

SPECTRAL

Spectral Applied Research Inc.

A Division of Andor Technology

2 East Beaver Creek Rd., Bldg. #2,
Richmond HIll, ON

Canada

L4B 2N3.

Web: www.spectral.ca

ANDOR
an Oxford Instruments company

Andor Technology

An Oxford Instruments Company

7 Millennium Way

Springvale Business Park

Belfast

BT12 7AL

Northern Ireland

Web: www.andor.com

1.1 Technical Support

If you have any questions regarding the use of this equipment, please contact the representative* from whom your system was purchased, or:

Europe

Andor Technology

7 Millennium Way

Springvale Business Park

Belfast

BT12 7AL

Northern Ireland

Tel. +44 (0) 28 9023 7126

Fax. +44 (0) 28 9031 0792

www.andor.com/contact_us/support_request

USA

Andor Technology

425 Sullivan Avenue

Suite # 3

South Windsor

CT 06074

USA

Tel. +1 (860) 290-9211

Fax. +1 (860) 290-9566

www.andor.com/contact_us/support_request

Asia-Pacific

Andor Technology (Japan)

IS Building

3-32-42 Higashi-Shinagawa

Shinagawa-ku,

Tokyo 140-0002

Japan

Tel: +81-3-6732-8968

Fax: +81-3-6732-8939

www.andor.com/contact_us/support_request

China

Andor Technology

Room 1213, Building B

Luo Ke Time Square

No. 103 Huizhongli

Chaoyang District

Beijing,100101 P.R.

China

Tel: +86 (0)10 51294977

Fax. +86(0)10-6445-5401

www.andor.com/contact_us/support_request

* The latest contact details for your local representative can be found on our website.

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The publication of information in this documentation does not imply freedom from any patent or proprietary right of Andor Technology or any third party.

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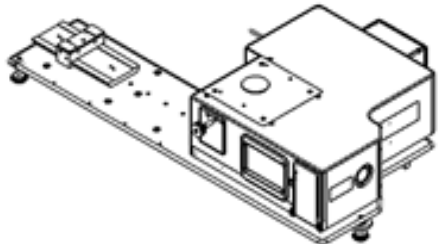
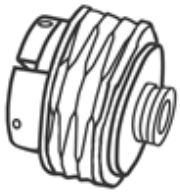
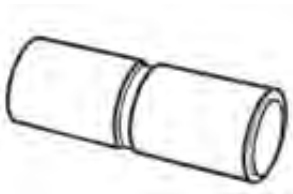
Spectral Applied Research Inc. is a Division of Andor Technology. Andor and the Andor logo are trademarks of Andor Technology. Andor Technology is an Oxford Instruments company. All other marks are property of their owners.

Changes are periodically made to the product and these will be incorporated into new editions of the manual. New releases of the manual are available through MyAndor: http://my.andor.com/login.aspx.

1.5 Supplied Components

Description		Quantity
	**Diskovery** CR-DISK-CONF Diskovery with Confocal	1

	Bellows Adapter (Microscope specific)	1
	Camera Lens Tube (Camera specific)	1
	Power Supply (with country specific power cord)	1
	Hardware Guide (in electronic format)	1

1. Diskovery may be ordered with TIRF option (see Section 1.6)
2. Diskovery may be ordered and configured for 2 cameras and emission filter wheels (see Section 1.6)
3. Additional camera Lens Tubes may be supplied as ordered (see Section 1.6)

1.6 Optional Components

There are a range of optional components available for the Diskovery system including:

- Andor iXon Ultra 897/888 EMCCD or Zyla and Neo sCMOS scientific cameras
- ASI FW-1000 High Speed Filter Wheel (8 position)
- 3D Camera Lens for Super-Resolution
- Bellows Adapter for Leica Auto-focus microscope
- Additional Confocal Disk and storage box

Please contact your nearest Andor Sales Representative for further information on these and other system components available.

SECTION 2: PRODUCT OVERVIEW

The Diskovery instrument is a multi-modal imaging platform that is used with a research-grade microscope to image biological samples for research applications.

2.1 General

The Diskovery product is intended to be integrated into an assembled system of components which consists of a laser source, a Borealis beam conditioning unit (BCU), the Diskovery instrument, and a research-grade microscope. The recommended light source (integrated separately) provides selected laser output(s) via either single-mode or multi-mode optical fibres. The multi-mode fibre is connected to a Borealis BCU (integrated separately), the output of which is connected to one input of Diskovery. The Diskovery is intended to provide three imaging modes in one instrument: Spinning disk confocal microscopy using the multi-mode input from the BCU; Borealis Wide Field (BWF) using the multi-mode input from the BCU; Total internal reflection fluorescence (TIRF) microscopy via single mode input from the laser source. Figure 9 shows the Diskovery without the laser source or the BCU.

Figure 9: The Diskovery shown with iXon Ultra EMCCD and Zyla sCMOS cameras attached.

2.2 System Configurations

The Diskovery instrument is configured with BWF and Confocal capability. The instrument can be upgraded for additional TIRF capability. Thus, there are two models available:

- **CR-DISK-CONF** (containing BWF and DISK)
- **CR-DISK-TIRF** (consisting of the TIRF module as an upgrade to the above)

The Diskovery instrument is usually mounted onto a support sled so that a camera can be mounted for the horizontal output via imaging optics and an emission filter wheel. A second camera for the vertical output can be added that interfaces with imaging optics and a second emission filter wheel. A camera selector or an emission light splitter is provided that allows selection of either camera or both via a manual slide in mirror or a dichroic mirror respectively.

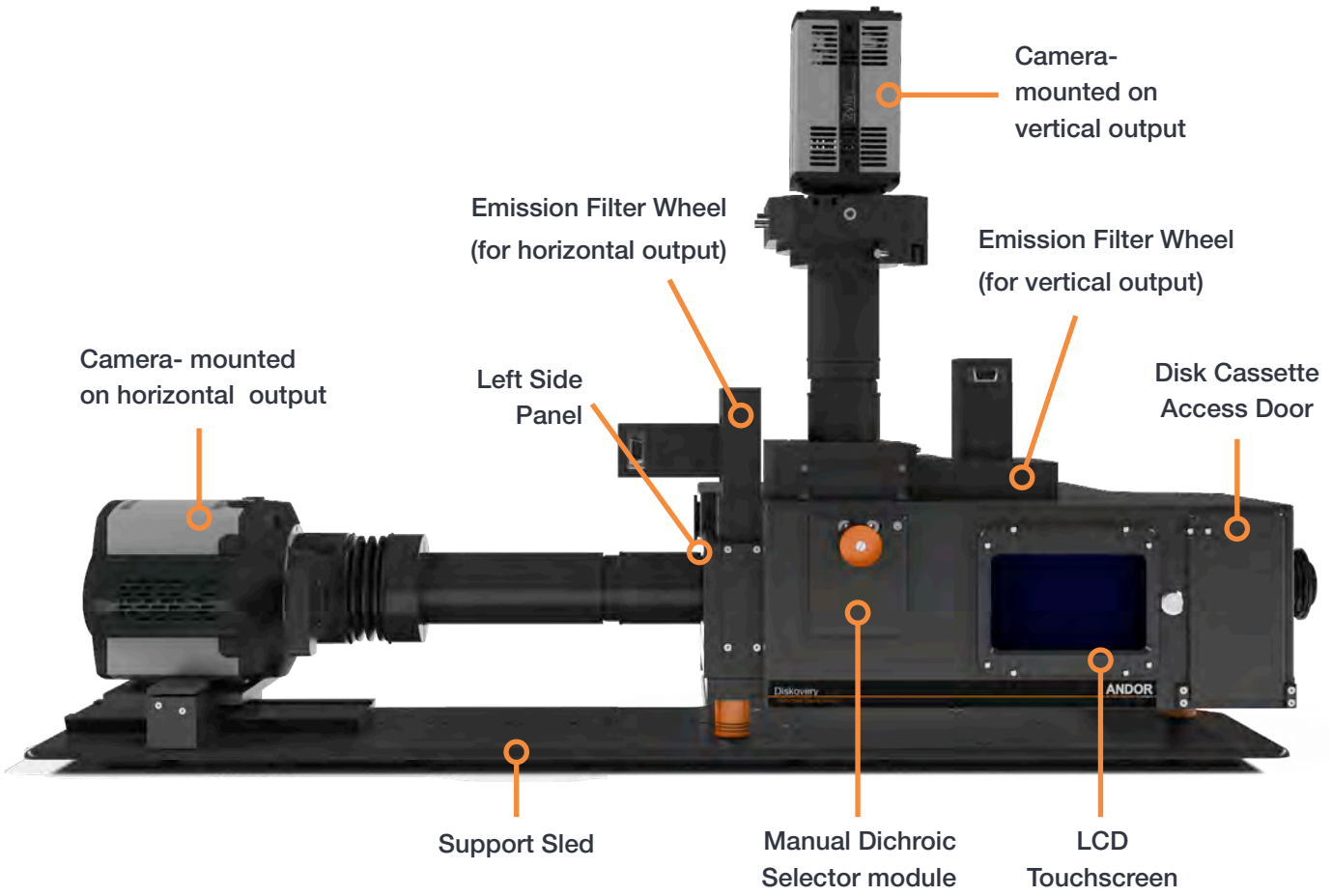

Camera- mounted on vertical output
Emission Filter Wheel (for horizontal output)
Emission Filter Wheel (for vertical output)
Camera- mounted on horizontal output
Left Side Panel
Disk Cassette Access Door
Support Sled
Manual Dichroic Selector module
LCD Touchscreen

Figure 10: Overview of the main hardware features of a typical Diskovery configuration

2.3 Interfaces and Controls- Left Side Panel

The connections and interfaces on the left side panel of the Diskovery are outlined in the following section:

Figure 11: Left Side Panel of the Diskovery

2.3.1 Power Input

A 2.5 mm input connector on the left side panel is used to provide DC power from the power supply unit to the Diskovery. The Diskovery requires a Direct Current (DC) power supply. This is provided by the supplied external PSU. For further information, please refer to Section 2.5.

2.3.2 ON/OFF Switch

A power switch enables power to Diskovery to be switched on or off.

2.3.3 USB

The Diskovery is controlled by the control PC through the USB 2.0 connection.

2.3.4 Interlock Output

An Interlock connection (BNC type) must be connected to the laser source so that if the Disk Cassette Access Door (Section 2.4.3) is opened (to exchange discs), the Interlock signal is open-circuited and the laser source shuts off all lasers. In addition, the confocal disk stops spinning and is withdrawn from the optical path. The installed Diskovery platform includes an interlock system for the Diskovery and microscope that is tied into the laser sources Remote Interlock circuit (refer to Section 2.9).

2.3.5 Fibre Input

The fibre Input (shown unconnected in figure 8) is used for to connect to the Borealis BCU multi-mode output. This enables the Diskovery to offer both Spinning disk confocal microscopy and Borealis Wide Field (BWF) modes through this optical connection.

2.4 Interfaces and Controls- Front Panel

There are a number of interfaces on the front panel of the Diskovery- these are outlined below:

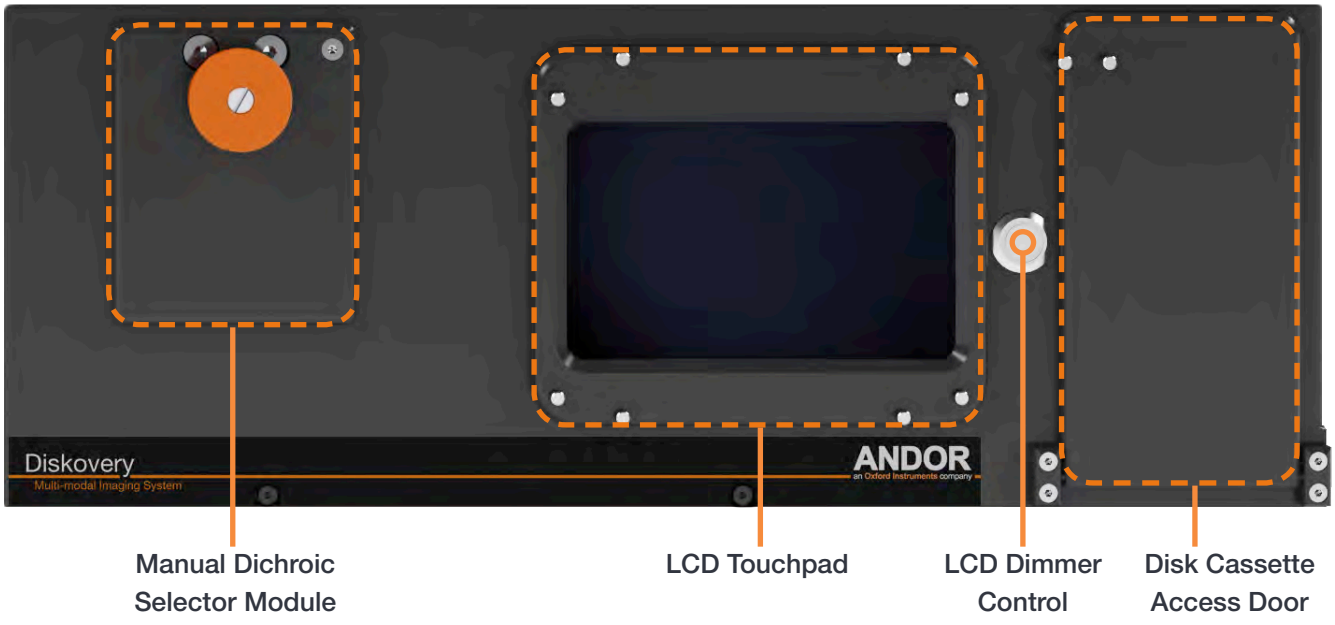


Figure 12: Front Panel of the Diskovery

2.4.1 LCD Touchpad

The LCD screen is located on the front panel and provides touchpad controls to allow manual, as well as the computer-controlled operation via sofwate such as µManager and Metamorph. A LCD dimmer button is adjacent to the screen that allows the brightness of the LSD screen to be adjusted if necessary. For future information please refer to Section 4.5.1.

2.4.2 Manual Dichroic Selector Module

The Manual Dichroic Selector Module enables the user to easily select the required dichroic (or bypass). The dichroics installed in each position are indicated on a label the Module.

2.4.3 Disk Cassette Access Door

The Disk Cassette Access Door enables access to the Disk Cassette so that the Disk Cassette may be exchanged. For further information on exchanging cassettes, please refer to Section 4.7.1. The Disk Cassette Access Door is held closed magnetically. Microswitches indicate if the door is open or closed and are linked to the laser safety interlock system (Section 2.9). Therefore if the door is opened, lasers are switched off.

2.5 Power Supply

The Diskovery is supplied with a 12V DC 5.5A certified power supply. Do not use any other power supply. For further information please refer to Section 7.4.

PSU Specifications Summary	
Input	100-240 V AC, 50-60 Hz
output	12 V DC, 5.5 A

2.6 Diskovery- System Integration

2.6.1 Overview

The integration of the Diskovery system involves the connection of the laser engine, such as the ILE, to the Diskovery unit via multi-mode fibre via the BCU to the Diskovery BWF input and, optionally, via single-mode fibre to the TIRF module (if present), where is is processed by the Diskovery. The output of the Diskovery is delivered to a research-grade microscope using coupling optics. The fluorescence emission light returning from the microscope sample is returned to the Diskovery via the same path. The Diskovery directs this emission light to the camera(s) after passing through an emission filter loaded in a manual paddle, or a motorized filter wheel. Figure 8 below provides a simplified schematic of the Diskovery Platform integrated as a larger system.

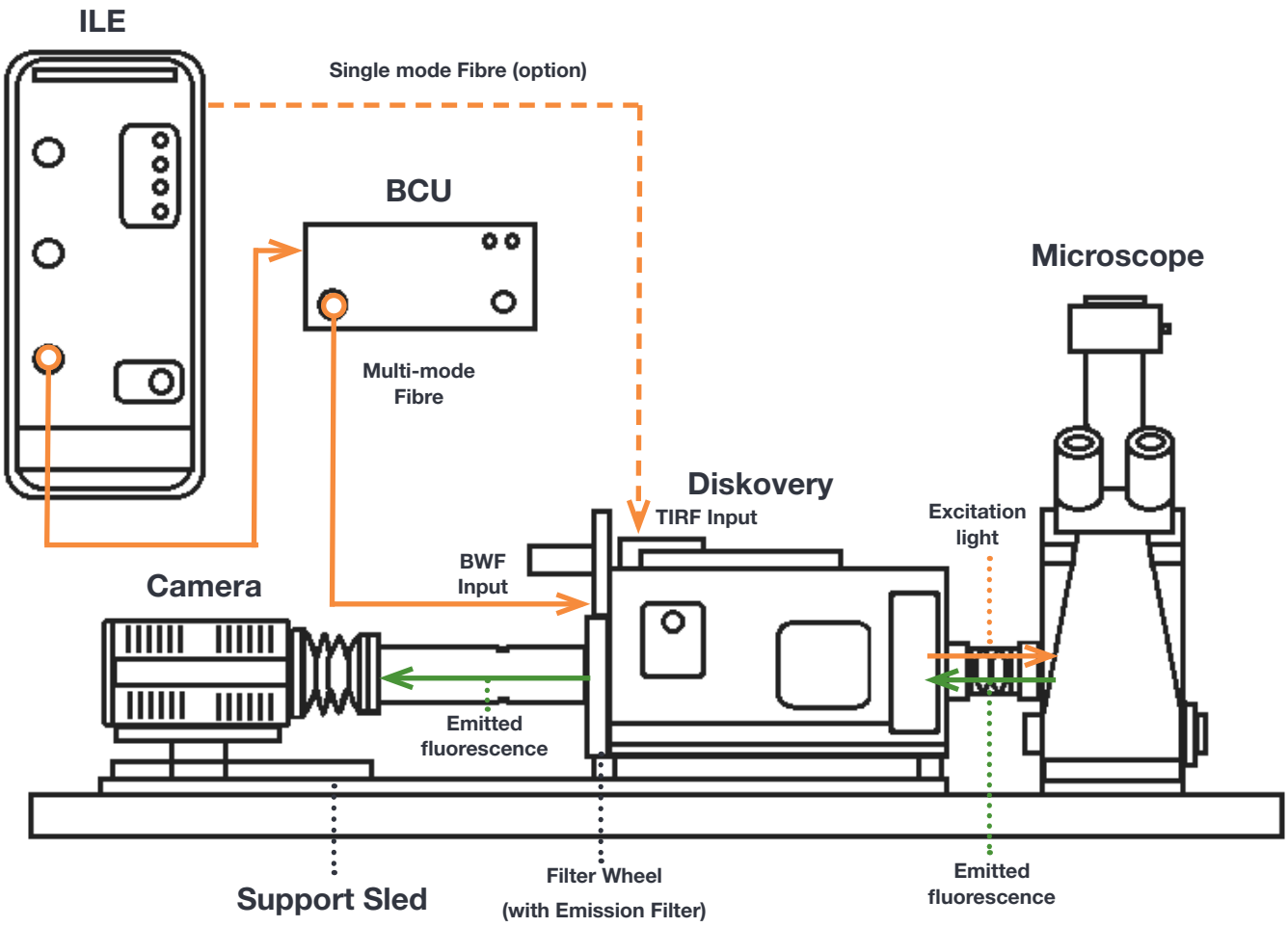


Figure 13: Overview of the Diskovery integrated into a typical system

2.7 Optical Paths

An appropriate wavelength and power level for the specific experiment e.g. using a fluorescent probe, is set for the ILE (Laser combiner). The light of the required wavelength and power passes to the Diskovery, normally via the Borealis BCU.

The light is processed by the Diskovery as represented in Figure 14 and the output of the Diskovery is then delivered to the microscope via coupling optics. The reflected/scattered or radiated emission light emitted from the microscopic specimen (typically, living biological cellular samples) re-enters the Diskovery and is directed to one or two cameras (typically EMCCD or sCMOS types). The fluorescent light generated by the sample returns to the Diskovery where it is imaged onto the camera(s). Residual laser light is filtered along the return path using appropriate interference filters (typically OD6 or greater) loaded into a manual paddle or an emission filter wheel situated before the camera.

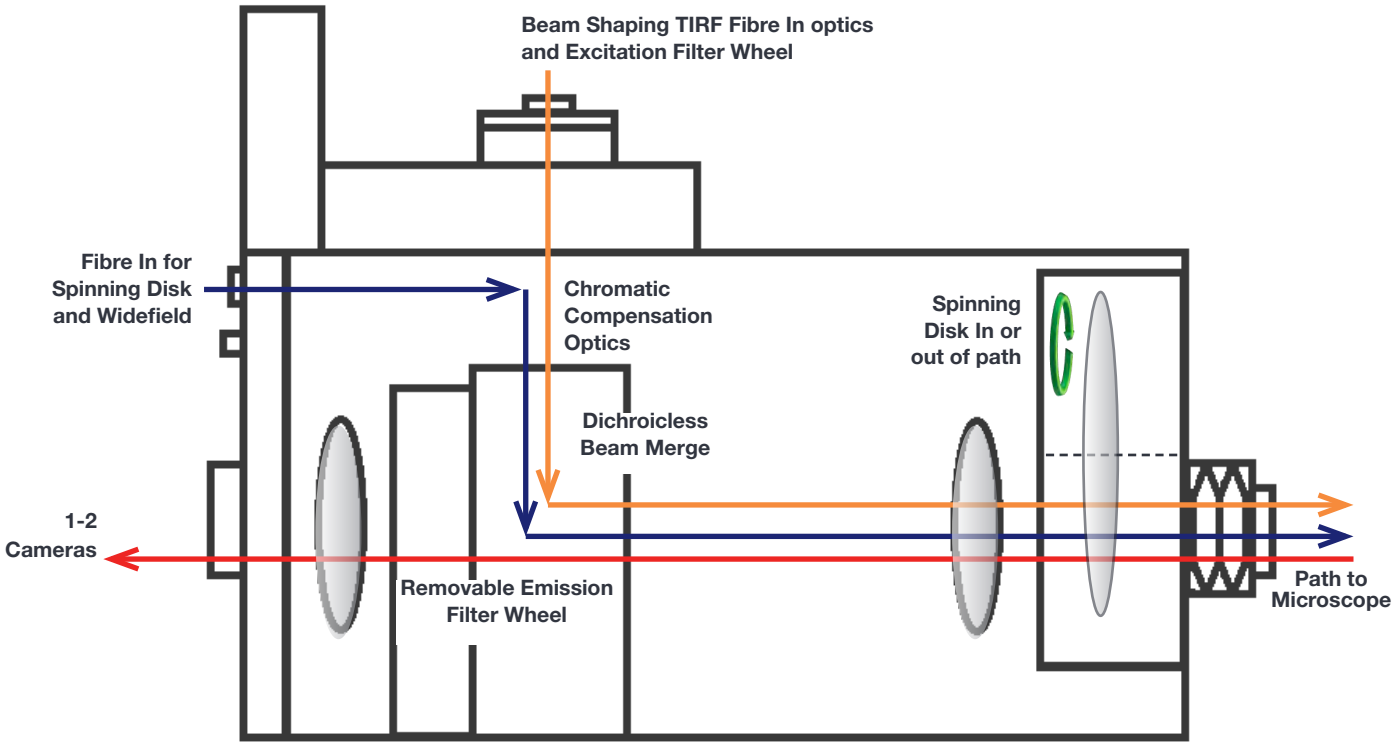


Figure 14: A representation of the Optical Paths of the Diskovery

2.7.1 Bellows Adapter

The bellows adaptor facilitates strain-free alignment and connection of the Diskovery to the microscope. Adaptors are specific to the microscope model.

2.8 Laser Sources

The Diskovery is compatible with a wide variety of laser sources including the Andor ILE and ALC-601 laser combiners. Refer to the information supplied by the manufacturer for each laser source.

2.9 Interlocks

The laser safety interlock system connects the laser source e.g. ILE to the Diskovery and the microscope in series as shown in Figure 15. The laser source provides a small current to test if the interlocking circuit is complete. The interlock will cut power output from the lasers if the Disk Cassette Access Door (Sections 2.4.3 and 4.7.1) is opened, or if an open circuit is detected in any other part of the interlock system. Microscope interlock connections (shown below) depend on the model, but typically include interlock connections for the eyepieces and microscope arm.

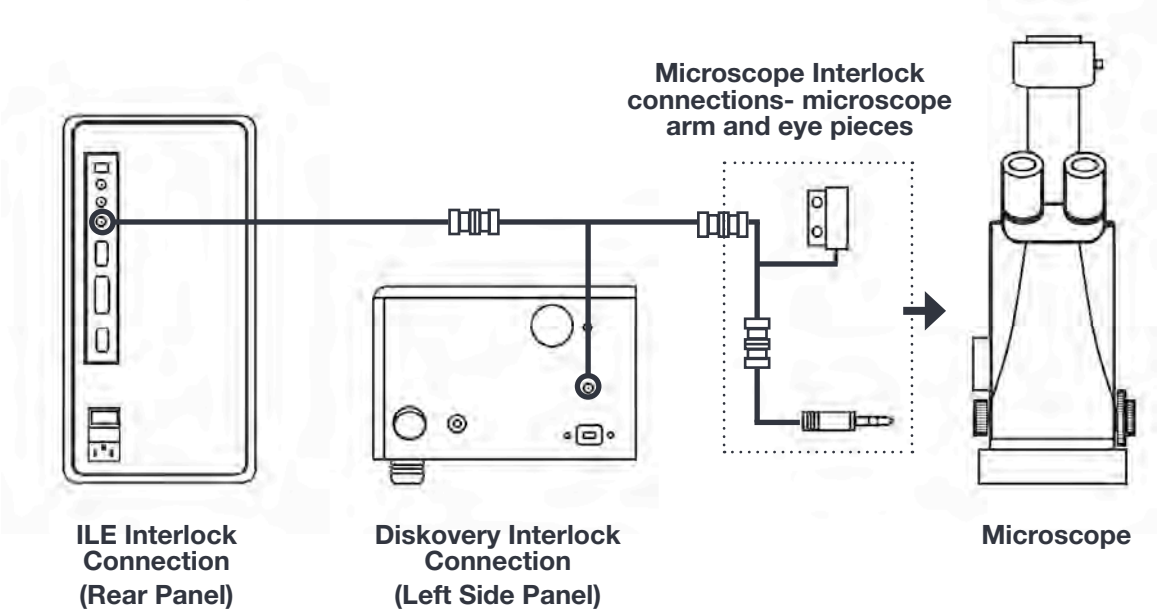

Microscope Interlock connections- microscope arm and eye pieces
ILE Interlock Connection (Rear Panel)
Diskovery Interlock Connection (Left Side Panel)
Microscope

Figure 15: Outline of Interlock connections for the laser source, Diskovery and microscope.

SECTION 3: INSTALLATION

WARNINGS:

- **THE DISKOVERY SYSTEM MUST BE INSTALLED BY AN AUTHORIZED INSTALLATION ENGINEER ACCORDING TO THE INFORMATION PROVIDED BY SPECTRAL OR ANDOR.**
- **THE DISKOVERY WEIGHS OVER 18 KGS (40 LBS). DUE CARE MUST BE TAKEN WHEN LIFTING THE DISKOVERY AS OUTLINED IN THE ANDOR INSTALLATION AND SERVICE MANUAL. WHEN MOUNTED TO THE SLED THE TOTAL WEIGHT OF THE DISKOVERY AND SLED IS 27 KGS (60LBS) AND REQUIRES A TWO PERSON LIFT.**
- **ONCE INSTALLED AND SECURED TO THE OPTICAL BENCH IT SHOULD NOT BE NECESSARY TO MOVE OR ADJUST THE MOUNTING OF THE DISKOVERY OR OTHER COMPONENTS. IF THIS IS REQUIRED, PLEASE CONTACT YOUR ANDOR REPRESENTATIVE FOR FURTHER INFORMATION.**
- **ANY INSTALLATION STEPS INVOLVING LASERS MUST BE PERFORMED BY QUALIFIED PERSONNEL USING PERTINENT LASER SAFETY PROTOCOLS**
- **SETUP AND OPERATION OF OTHER SYSTEM COMPONENTS ARE DESCRIBED IN THEIR RESPECTIVE GUIDES AND MANUALS.**

3.1 Location and Mounting

- Temperature and humidity must meet the specifications defined in SECTION 7.
- Operational vibrations should be reduced as much as possible for stability of the imaging train.
- It is recommended that the Disokvery is mounted on a damped optical table. Please contact your Andor Representative for assistance in specifying and ordering a suitable table.
- Power cabling and control cables should be routed to prevent accidents, damage and accidental unplugging while avoiding bend radii of less than 30 mm.

3.2 Ventilation

Do not cover equipment during operation.

3.3 Assembly

This product requires no assembly by the user and is recommended to be installed by an installation engineer authorized by Spectral, Andor or authorized distributor.

3.4 Filter Wheels

One or two emission filter wheels are generally provided with the Diskovery. These will be installed by the technician and locked in place. These devices are not user accessible.

If it is necessary to change or add a filter, please contact the nearest Andor representative. Note that only certain filters have been certified to date for Diskovery.

3.5 Classification of an Installed System

The following information provides a reference on how Andor classify a system which is configured with a number of system components, one of which is a laser a source, prior to installation. Refer also to the Laser Safety Information Section in the preface of this manual.

The proposed installation scheme of all systems is captured and assessed for all orders received by Andor. It is the responsibility of the System Integrator to ensure that the final assembled product is assessed and correctly classified and labelled according to IEC 60825-1 or the regional equivalent. This assessment must be conducted by a trained and competent individual e.g. the site's Laser Safety Officer.

Most devices are classified as 3B during factory QC due to the known and measured powers from the selected laser source. If the laser source is not provided by Andor and is of high power (>500mW) then the assembled system should have its maximum accessible emissions measured at the microscope's nose-piece with no objective present.

The device documentation will include a Classification Label sheet which includes all required variations of the labels to allow reclassification of the system if required. The following test criteria should be applied if a system is felt to be fully enclosed e.g. uses a stage cover and / or environmental enclosure.

Assess if any of the laser emissions are open to Human Access as defined by:

1. Ability of the human body to meet laser radiation emitted by the laser product, i.e. radiation that can be intercepted outside of the protective housing, or
2. Ability of a cylindrical probe with a diameter of 100 mm and a length of 100 mm to intercept levels of radiation of Class 3B and below, or
3. Ability of a human hand or arm to intercept levels of radiation above the AEL of Class 3B
4. Also, for levels of radiation within the protective housing that are equivalent to Class 3B or Class 4, ability of any part of the human body to meet hazardous laser radiation that can be reflected directly by any single introduced flat surface from the interior of the product through any opening in its protective housing.

The standard Ophir PD-300W sensor and power meter can be used to assess accessible power levels in conjunction with suitable Safety Glasses and applicable Safe Systems of Work. Any queries should be referred to the Andor Product Laser Safety Officer for guidance.

If Human Access is not possible then the device should be reclassified as a Class 1 device. This involves the following steps:

1. Remove all other Explanatory (Classification) Labels EXCEPT those on the Laser Sources (these count as Removable Laser Sources and need to remain labelled and classified as stand-alone products).
2. Fit a Class 1 Explanatory Label onto a permanently affixed surface which is easily visible before and during operation of the system.
3. Ensure a Laser Hazard Symbol is clearly visible before and during operation and affix a label if not.

SECTION 4: OPERATION

WARNINGS:

- **IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY SPECTRAL OR ANDOR SYSTEM DISTRIBUTORS, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.**
- **READ THE USER GUIDES SUPPLIED WITH YOUR SYSTEM COMPONENTS AND SOFTWARE PRIOR TO USE**

4.1 Emergency Mains Disconnection

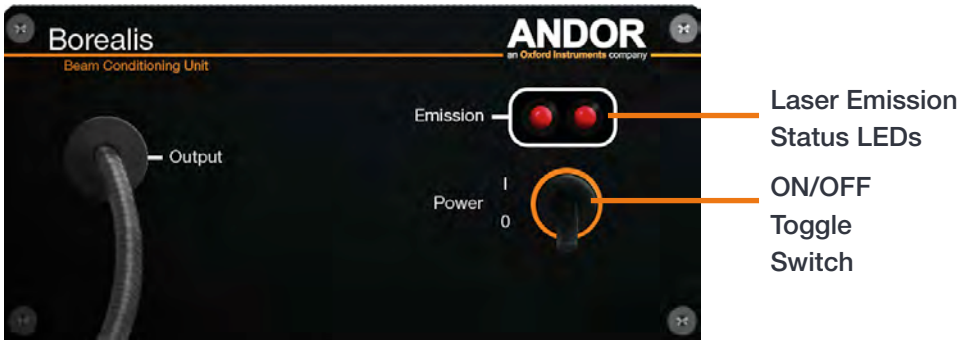
In case of emergency, the disconnecting point of the equipment is the mains power cord connected to the external power supply, or the mains socket switch.

WARNING: SWITCH OFF THE POWER AT THE MAINS SOCKET AND REMOVE THE MAINS LEAD FROM THE EXTERNAL POWER SUPPLY.

4.2 Power-up Sequence

1. Turn on and log in to the control PC/workstation.
2. Turn on the Diskovery using the rocker switch on the left side panel (shown below).

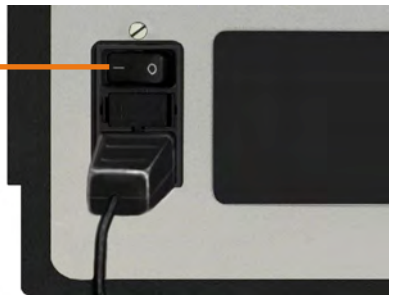
3. Turn on the BCU using the toggle switch on the front panel (refer to the Borealis Hardware Guide).



4. Confirm that the Emission LEDs turn on.

5. Turn on laser source according to manufacturer's instructions. Note that the ILE has an ON/OFF switch at the rear of the unit, and the ON/OFF key on the front panel.

ON/OFF Switch on ILE rear panel



ON/OFF Key switch on ILE front Panel

6. The system can now be used as outlined in the user guides.
7. Refer also to your user guides supplied with your image acquisition software e.g Andor iQ.

4.3 Power-down Sequence

In order to turn the system off, proceed as follows:

1. Exit the control software.
2. Turn off the laser source.
3. Turn off the Diskovery using the rocker switch.
4. Turn off the BCU using the front panel toggle switch.
5. Power off the control PC/workstation

4.4 Risk Mitigation

4.4.1 Mechanical Housings

Once installed, the Diskovery Platform, microscope, filter wheel(s), and camera(s) form the protective housings of the product. No components, panels, connections or linkages should be loosened or removed to avoid exposure to hazardous radiation.

4.4.2 Hazards due to Moisture or Liquids

Do not put any components including power cables or external power supply in places with high moisture or near water.

4.5 Using the Diskovery

There are two ways to control the Diskovery:

1. Using the **Diskovery LCD touchpad** user interface on the front panel of the instrument.
2. Using the **Diskovery Control Utility** supplied with the instrument. This computer application is required to operate the TIRF module.

4.5.1 LCD Touchpad User Interface

The graphical user interface (GUI) of the Control Utility application was designed to mimic the layout of the touchpad user interface screen. The figures included in this section apply to both the touchpad screen and the computer GUI except where noted.

Figures 16 and 17 show the main control panel for versions with and without the optional TIRF module respectively. Figure 16 shows the GUI as it appears in the computer Control Utility application. On the touchpad LCD screen, the text outside the green box is not present. Also note that the button labelling can be customized by the installer so the screen may not be identical to that shown below.

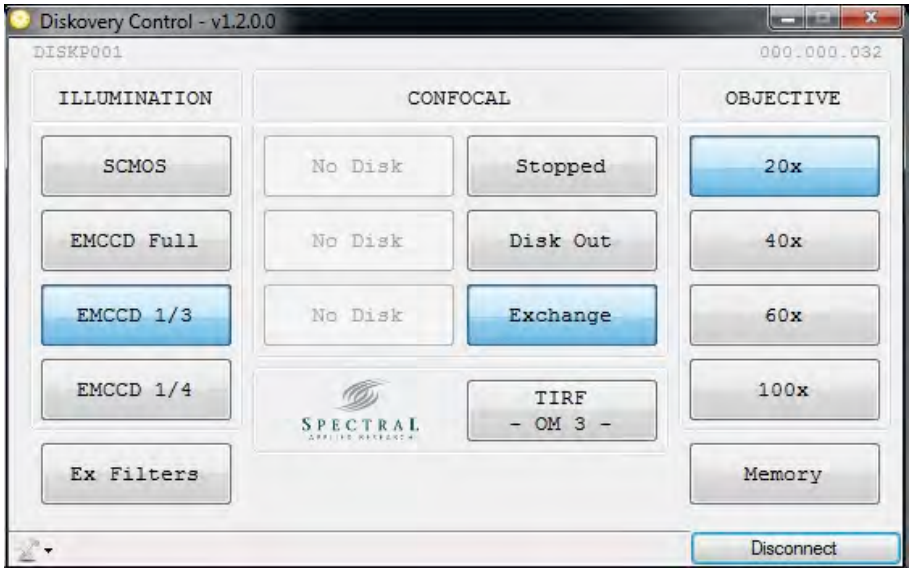


Figure 16: Main Screen of the Diskovery Control Utility with TIRF

Figure 17: Main Screen of the Diskovery Control Utility without TIRF

The main control panel shows all of the available non-TIRF functions. The user can select the square field of illumination size, the confocal disk pinhole size and the microscope objective magnification. The user can also insert and remove the disk from the optical path (Disk Out for widefield or TIRF). The disk can also be stopped. In some units, the user can also change the excitation filter (if the excitation filter wheel is present). Any combination of configuration settings can be saved and recalled at a later time.

Field of illumination size

The user can select from one of four illumination sizes shown in the left hand side of the GUI. The labelling can be customized to a particular application. In general, the top two sizes are for confocal or traditional widefield while the bottom two are smaller fields intended for high intensity illumination used in super-resolution applications.

Confocal

1. **Pinhole size** – select one of two available pinhole sizes (3 on some obsolete disks, as shown in the figures above). Change will be made in approximately 6 seconds.
2. **Exchange** – to exchange or remove confocal pinhole disk cassette, the lasers should first be turned off. The exchange button can then be pressed to move the disk cassette to the exchange position. The disk cassette is removed through the access door after unlocking using a 3 mm driver (see Section 4.7.1).
3. **Disk start/stop**. This allows the disk rotation to be stopped. This function is used mainly by the installer to check that the pinholes are well focused on the camera.

TIRF

The TIRF functionality cannot be controlled through the Diskovery Platform LCD touchpad user interface screen. User's can only enable or disable the TIRF capability through the touchpad. The TIRF module can only be controlled through the Control Utility application's GUI.

Ex Filters

This button (available only on units that possess an excitation filter wheel) opens the window shown in Figure 18 and allows the user to select an excitation filter from up to a maximum of 4.

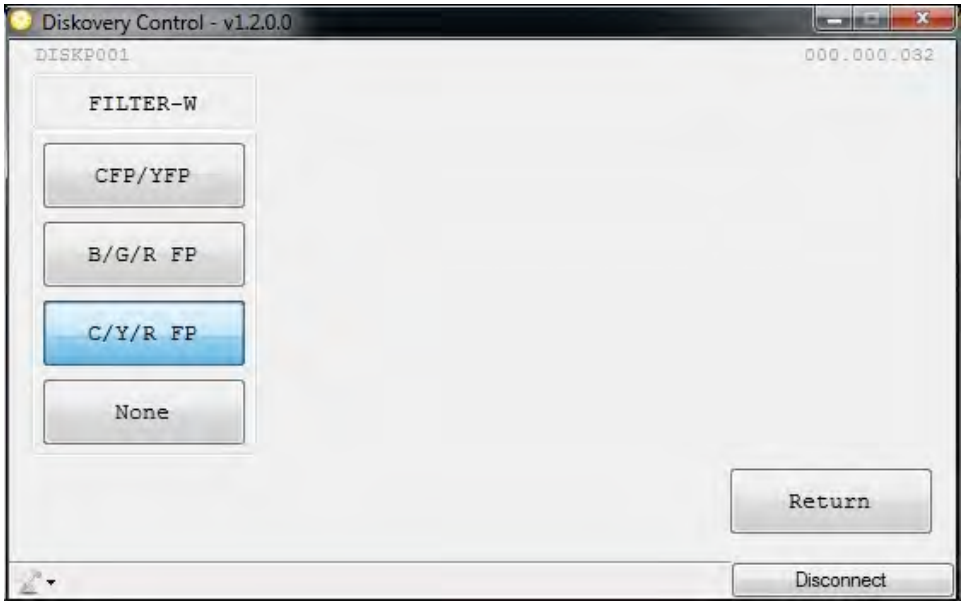


Figure 18: Excitation filter wheel screen with sample filter names shown

Memory

The memory button opens the window shown in Figure 19 and allows the user to save and recall up to 4 different Diskovery configuration settings.

Figure 19: Configuration Memory Buttons

4.5.2 Computer Control Utility Application GUI

The following sections explain how to connect to the Diskovery through the Control Utility application.

Connection

After launching the application, a computer connection to the Diskovery Platform must be established through one of the computer's COM ports. A right click on the button on the bottom-left corner of the GUI will present four options: Connection, Reset Device, TIRF Setup, and Help.

Select "Connection".

Figure 20: Connection menu with TIRF

Under Port Name, select Spectral Diskovery Platform as shown in Figure 21.

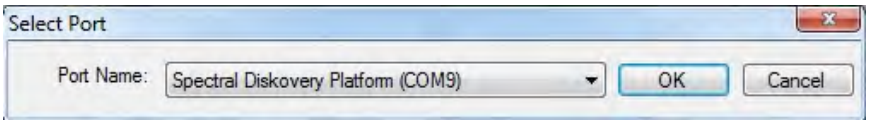


Figure 21: Connection Select Port

On the same menu as the Connection button is a Reset Device button. You may be asked to reset the device during a remote troubleshooting session with a service engineer.

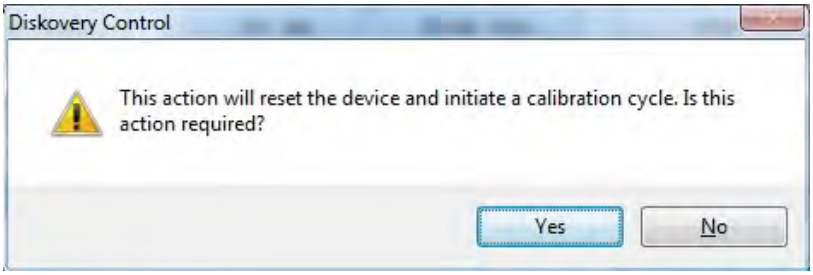


Figure 22: Reset Device

Figure 23 shows the main screen once with the device connected. It is almost identical to the Diskovery Platform LCD touchpad user interface main screen. All buttons except for the TIRF button have been described above. If the TIRF is button is selected, TIRF control panel (Figure 24) is shown.

Figure 23: Main Screen

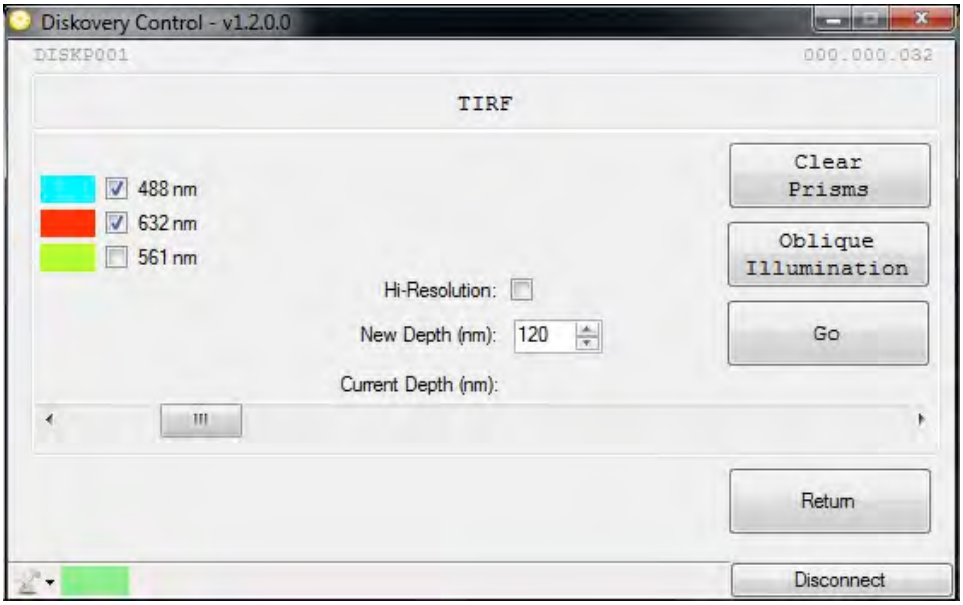


Figure 24: TIRF Menu

Figure 25 shows the screen with the prisms inserted. The user should now select the TIRF wavelength or wavelengths.

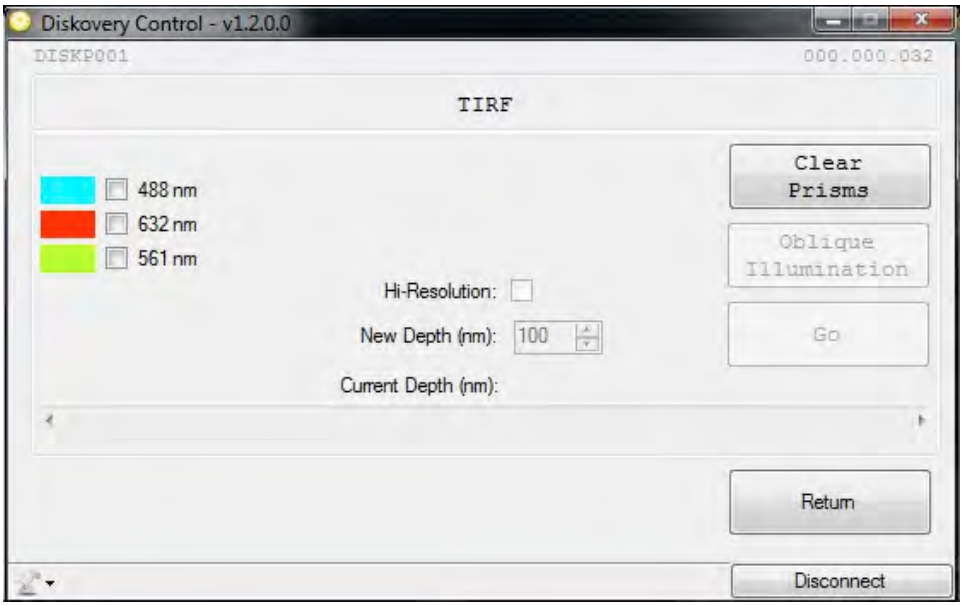


Figure 25: TIRF Menu – no wavelengths selected

Figure 26 shows two wavelengths selected and the “Go” button has been pushed to adjust the penetration depth to 120 nm. The user can adjust the penetration depth by dragging the penetration depth slider OR by using the drop-down box. If the drop-down box is used, the “Go” button must be pushed to make the change. The Hi-Resolution button changes the penetration depth step size from 10 nm to 1 nm.

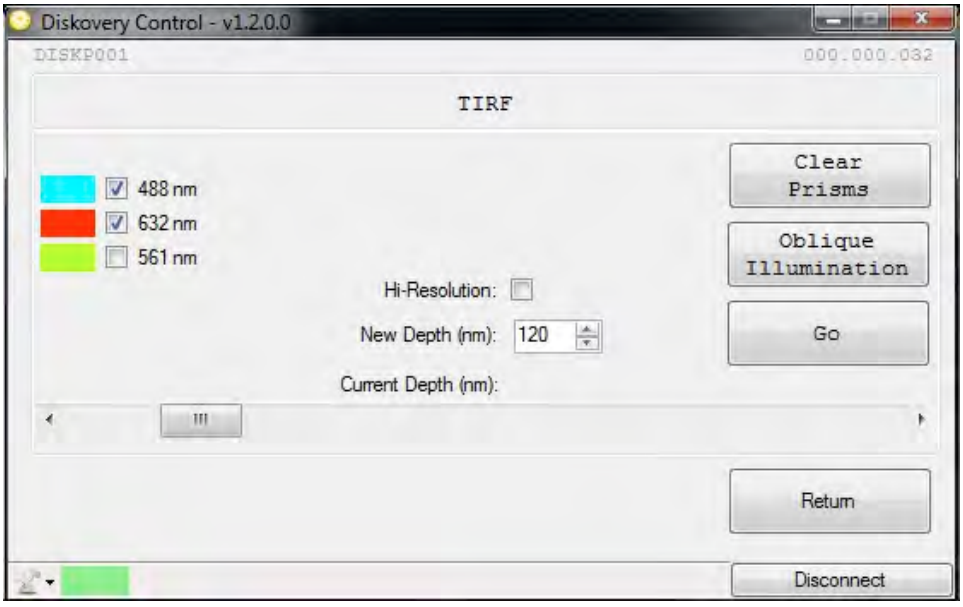


Figure 26: TIRF Menu – wavelengths selected and penetration depth set

The last control on the screen is the “Oblique Illumination” button shown in Figure 26. Selection of this option takes the system out of TIRF and into sub-critical angle oblique widefield illumination.

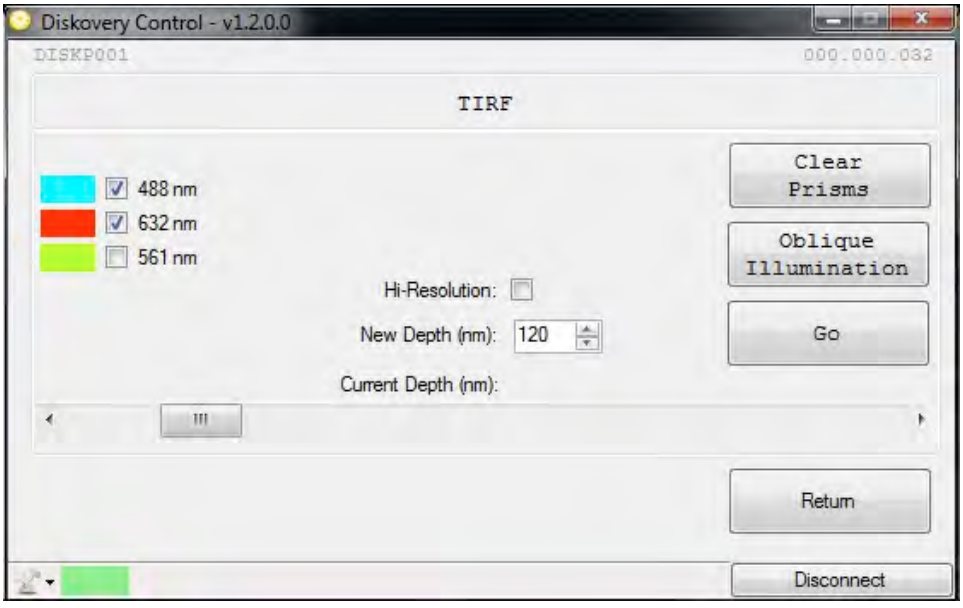


Figure 27: TIRF Menu – Oblique Illumination (Dirty TIRF) Selected

To exit the TIRF control, the user should push the return button shown in Figure 27.

4.6 Diskovery Control: About

The About screen gives information for the Diskovery including: serial number, and the software, hardware and firmware versions.

Figure 28: The Diskovery About Screen

4.7 Additional Procedures

The Diskovery Platform confocal pinhole disk cassette is designed to be user exchangeable with other disk cassettes, permitting the user to image their microscopic specimens with varying degrees of confocality, resolution, and image signal strength.

WARNING

- **When handling an unmounted disk cassette, avoid contact with the transparent cassette optical windows.**
- **The confocal pinhole disk cassette should only be accessed on a Diskovery Platform system that has been properly interlocked.**

4.7.1 Removing the disk cassette

To remove a confocal pinhole disk cassette from the Diskovery Platform, perform the following steps:

1. Turn off the lasers
2. Push the exchange button on the LCD (or GUI) and wait until the display indicates that the disk has finished moving to the exchange position.
3. Pull down the confocal disk cassette access door (Figure 29) to access the disk cassette.

Figure 29: Opening Confocal Door to Access Cassette

Note: If the access door is opened while the disk is moving, it will automatically stop. The door must be closed again to allow the disk to finish moving to the exchange position.

4. Insert a 3 mm hexagonal Allen driver into the confocal disk cassette motorized stage lock (Figures 30a and 30b).

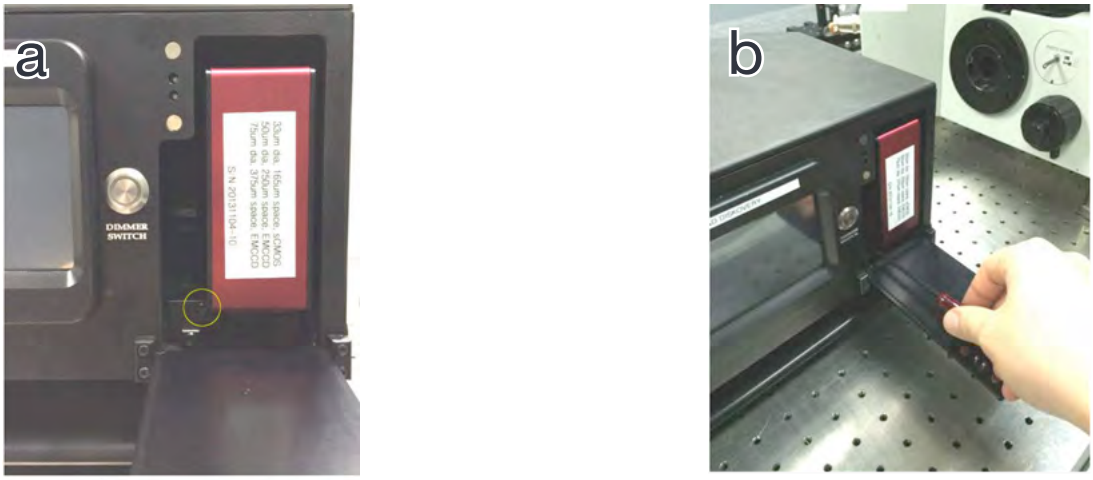


Figure 30: Accessing stage low screw (a), and Using a 3 mm hex driver to unlock the stage (b).

5. Turn the Allen driver counter clockwise until the disk cassette releases and slides out towards to the access door slightly.

6. Grab the disk cassette's two rounded corners facing outwards towards the door and pull the cassette straight out of the Diskovery platform.
7. Close the confocal pinhole disk cassette access door.
8. Store the un-mounted disk cassette in a dust free environment or the provided disk cassette box (Figure 31).

Figure 31: Diskovery cassette storage box

4.7.2 Exchanging a disk cassette

1. To exchange a confocal pinhole disk cassette into the Diskovery Platform, perform the steps outlined in Section 4.7.1 to remove the existing Disk Cassette (Installation of a different Disk Cassette is the opposite of the removal procedure).
2. Hold the disk cassette to be loaded into the Diskovery carefully by the two rounded corners facing outwards, and press the cassette straight into position.
3. Use a 3 mm hex driver to lock the Disk Cassette to the stage (see figure 30).
4. Close the Disk Cassette Access Door.

4.7.3 Operating the Diskovery Excitation Filter Wheel

The Diskovery Platform uses a standard 4-line ILE laser engine, which usually includes 405 nm, 488 nm, 561 nm, and 638 nm lasers. Occasionally, the Diskovery Platform may be used with a non-standard ILE laser engine configuration that includes additional or unconventional lasers with different wavelengths (such as 440 nm, 514 nm, 730 nm, etc.), thus necessitating the application of a motorized excitation filter wheel built into the Diskovery unit that carries various laser clean-up excitation filters. In this situation, the combined activation of various lasers within the laser engine must be coordinated with the filter switching action of the excitation filter wheel, which can be achieved by one of two methods:

- First, as various laser are activated, the excitation filter can be switched manually by the user by accessing the filter wheel position via the Diskovery Platform LCD touchpad interface screen or the Diskovery Platform computer control application (See Figure 16).
- Second, the excitation filter wheel can be switched via RS-232 serial communication through the image acquisition software. In this case, the system installer must define the excitation filter wheel position for each image channel so that the filter wheel will automatically switch to the appropriate excitation filter when a certain combination of lasers is activated.

Further information is available in Diskovery Command Set Document (SU-DSK502).

4.7.3.1 To check if the excitation filter wheel is active (i.e. installed)

Send the following serial command to the instrument:

Q: ACTIVE_FILTER_W

The device will respond with ACTIVE_FILTER_W=n

n=0: Inactive

n=1: Active

4.7.3.2 To move the excitation filter wheel to one of the preset filter positions

Send the following serial command to the instrument:

A: PRESET_FILTER_W,n

0<n<5

4.7.3.3 To query the current position of the excitation filter wheel

Send the following serial command to the instrument:

Q: PRESET_FILTER_W

The device will respond with PRESET_FILTER_W=n

0<n<5

These serial commands are supported from v0.0.31 of the Diskovery firmware.

The excitation filter identities and their loaded positions in the excitation filter wheel can be determined by observing the names and their ordering in the Ex Filter window of the Diskovery LCD touchpad interface screen or the Diskovery Platform control application (see Figure 16). Alternatively, the excitation filter identities and loaded filter wheel positions are documented in the shipping records that are delivered with each Diskovery Platform unit.

SECTION 5: MAINTENANCE

WARNINGS:

- **THERE ARE NO USER MAINTENANCE PROCEDURES REQUIRED FOR THE DISKOVERY PLATFORM.**
- **THE SYSTEM SHOULD BE POWERED-DOWN PRIOR TO USER PERFORMING ANY MAINTENANCE CHECKS.**
- **DO NOT USE EQUIPMENT THAT IS DAMAGED.**
- **CONTACT YOUR ANDOR REPRESENTATIVE IF THERE ARE ANY QUERIES OR ISSUES WITH YOUR DISKOVERY SYSTEM.**

5.1 Cleaning and Decontamination

The most critical aspect of maintenance by the user is to ensure that the system is in a clean environment that is suitable for sensitive electro-optical equipment. The laboratory should be free of dust, fumes and other materials that could affect the system.

- To clean the product, only use a damp, lint-free cloth on the external housing of the unit. Do not wet the connectors.
- Use water only- do not use solvents, cleaning agents, or aerosols.

5.2 Regular Checks

The state of the product should be checked regularly, especially the integrity of the enclosure and the mains cable.

On a Daily Basis:

- Visually inspect the system.
- Perform any maintenance activities suggested by the microscope and camera manufacturer(s).

On a Weekly Basis:

- Ensure that all power cables are firmly in place.
- Check the optical cables and connections to ensure that the locks are in place and no damage has occurred to the optical fibres connecting the various elements of the system.

5.3 Annual Electrical Safety Checks

It is advisable to check the integrity of the insulation and protective earth of the product on an annual basis, e.g. U.K. PAT testing.

SECTION 6: TROUBLESHOOTING

6.1 Troubleshooting Examples

The following examples provide guidance for some basic troubleshooting scenarios. Refer also to the operation and troubleshooting information provided with your other system components. Contact your Spectral or Andor customer support representative if you require further assistance.

6.1.1 No External Power Error Message

Fault	Action
Error Message "No External Power"	1. Check to make sure the 12V power supply is securely plugged in.

6.1.2 Confocal Access Door Open Error Message

Fault	Action
Error Message "Confocal Access Door Open Error Message"	1. Check that the Confocal Access Door is closed correctly.

6.1.3 No Laser Power at Diskovery

Fault	Action
No laser power out of Diskovery	1. Check that disk door is closed (Door is interlocked to shut lasers off if opened). 2. In TIRF mode, check that TIRF is enabled. 3. In widefield mode check that disk is in OUT position

6.1.4 Low Laser Power at Diskovery

Fault	Action
Low laser power at Diskovery	1. Contact your customer support representative.

6.1.5 Poor Uniformity over Camera FoV

Fault	Action
Poor uniformity over Diskovery FOV	1. Contact your customer support representative.

6.2 Problem Reporting Form

Please have the following information when connecting customer support:

Owner Information			
Institution		Name	
Vendor Information			
Vendor		Contact	
Equipment Information			
Model		Serial No.	
Check List			
Cable Connections		Emission LEDs	
Mains Power			
Summary			
What is the nature of the problem?			
Any other observations			

SECTION 7: TECHNICAL SPECIFICATIONS

7.1 Diskovery- General Specifications

Input wavelength range	400-785 nm
Input power	2W maximum from combined wavelengths
Output	As classified under IEC 60825-1 or the regional equivalent: 500 mW max. Class 3B, (typical). May be classed Class 4 with <1W max. with some laser combinations- refer to Laser Safety and Classification sections in the preface of this manual).
Excitation Uniformity	10% rms (15% rms at 405 nm)
Maximum frame rate (fps)	1000 (1 ms exposure)

7.2 Bellows Adapter

Standard

Length range (mm)	60 +/- 12

Compact Bellows

Length range (mm)	43 +/- 10

7.3 Environmental Specifications

Usage	Indoor use only
Altitude	Up to 2000 m
Operating Temperature	18°C to 28°C ambient
Storage Temperature	0°C to 50°C
Operating Relative Humidity	<70% (non-condensing)
Rated Pollution	Pollution Degree 2. Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
Ventilation Requirements	Do not cover during operation.

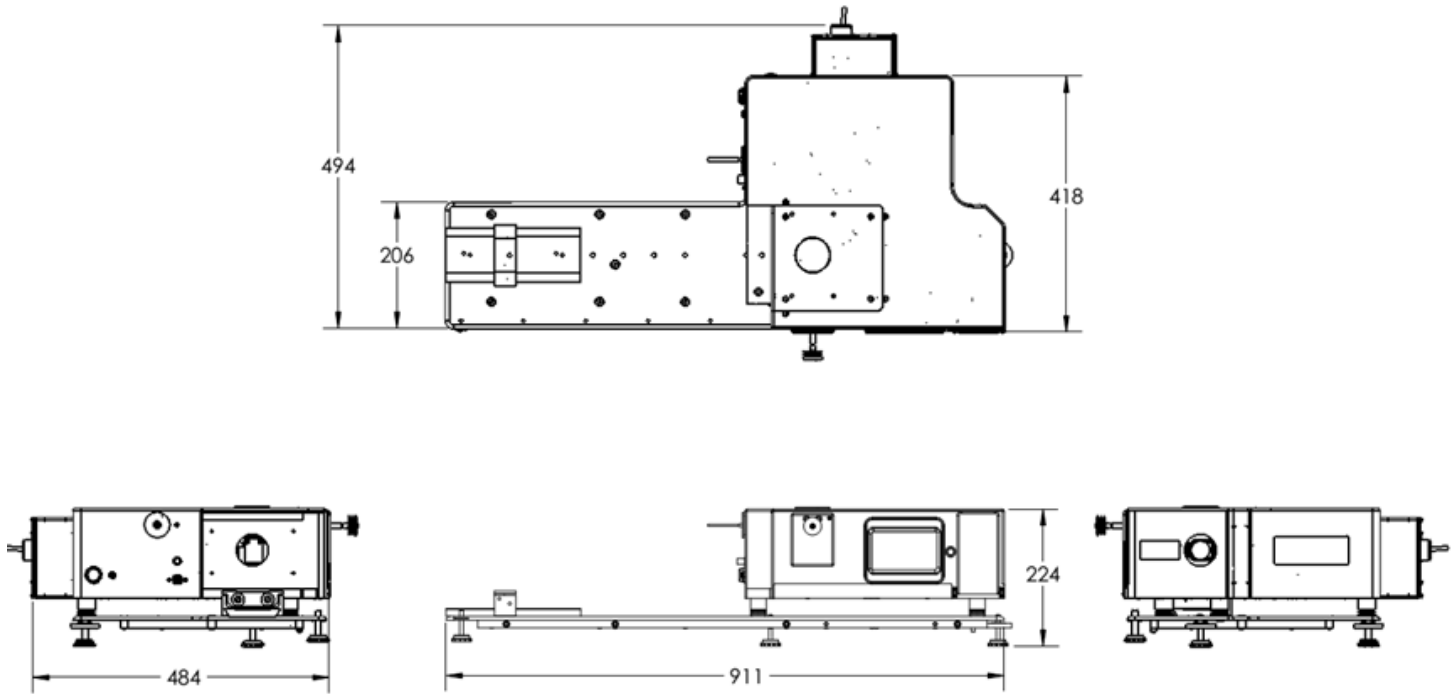
7.4 Power Specifications

External Power Input	100-240 V a.c. 50-60 Hz
Low Voltage Output	12 V d.c. ± 2%
Low Voltage Output Ripple and Noise	120 mV max.
Steady State Current Output	2 A min.
Power Supply Output Connector	2.5 mm coaxial (“barrel”) power plug, centre positive inner/ outer diameter = 2.5/ 5.5 mm)
Power Consumption	Diskovery + External Power Supply 32 W/40 W (Typ./ Max.) Diskovery Only 21 W/24 W (Typ./ Max.)
Overvoltage Category	CAT II. An overvoltage category of CAT II means that the equipment is designed to cope with transient voltages above the rated supply that would be experienced by any product connected to a mains socket in a building.

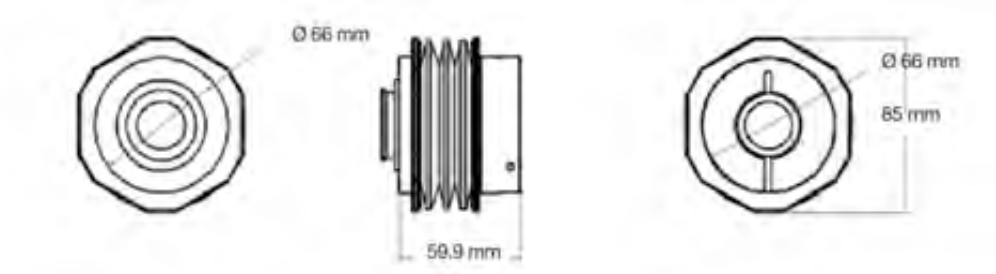
APPENDIX A: MECHANICAL DRAWINGS

All Dimensions: mm [inches]

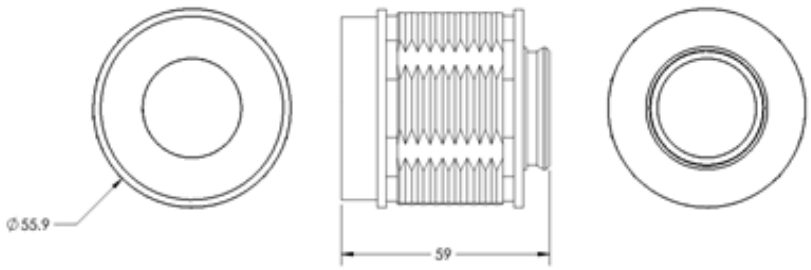
Diskovery Platform



Standard Bellows Coupling Adapter



Optional Compact Bellows Coupling Adapter



APPENDIX B: GLOSSARY

AC	Alternating Current (Mains)
AC/DC	An electronic device that converts AC electricity (usually mains) into a DC voltage (usually a safe low voltage)
ADC	Analogue-to-Digital Converter: Converts an analogue voltage to a digital signal.
AEL	Accessible Emission Limit: The maximum accessible emission permitted within a particular class. Wherever the text refers to “emission level not exceeding the AEL” or similar wording, it is implicit that the accessible emission is determined following the measurement criteria specified in Clause 9 of IEC 60825-1.
BCU	Beam Conditioning Unit: Homogenizes the light from the laser source to permit uniform illumination across the image
CSU	Confocal Spinning Disk
CLSM	Confocal Laser Scanning Microscopy
DC	Direct Current
Diffuse Reflection	Change of the spatial distribution of a beam of radiation by scattering in many directions by a surface or medium.
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EU	European Union
FC/APC	Fibre Optic connector (Angled Physical Contact)
IO	Input/Output: Generic input and output electrical signal connections
ILE	Integrated Laser Engine: Control for up to 4 individual lasers ILE-400 (and 7 in ILE-700, Primary/ Secondary configuration)
Intrabeam Viewing	All viewing conditions whereby the eye is exposed to the direct or specularly reflected laser beam in contrast to viewing of, for example, diffuse reflections.
LED	Light Emitting Diode
LMM	Laser Merge Module: Combines multiple laser wavelengths into a single fibre optic cable output.
MM	Multi-mode fibre: Multi-mode fibres have a much larger core diameter than single mode (SM) fibres. This enables improved transmission of longer wavelengths.
NOHD	Nominal Ocular Hazard Distance: Distance from the output aperture at which the beam irradiance or radiant exposure equals the appropriate corneal maximum permissible exposure (MPE)
MPE	Maximum Permissible Exposure: Level of laser radiation to which, under normal circumstances, persons may be exposed without suffering adverse effects. The MPE levels represent the maximum level to which the eye or skin can be exposed without consequential injury immediately or after a long time and are related to the wavelength of the laser radiation, the pulse duration or exposure duration, the tissue at risk and, for visible and near infra-red laser radiation in the range 400 nm to 1 400 nm, the size of the retinal image. Maximum permissible exposure levels are (in the existing state of knowledge) specified in Annex A of IEC 60825-1.
Specular Reflection	Reflection from a surface that can be considered a beam, including reflections from mirrored surfaces.
TIRF	Total Internal Reflection Fluorescence (Microscopy).

APPENDIX C: OTHER INFORMATION

Terms and Conditions of Sale and Warranty Information

The terms and conditions of sale, including warranty conditions, will have been made available during the ordering process. The current version may be viewed at: http://www.andor.com/pdfs/literature/Andor_Standard_Warranty.pdf

Waste Electronic and Electrical Equipment Regulations 2006 (WEEE)

The company's statement on the disposal of WEEE can be found in the Terms and Conditions